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April 18, 2005

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APPLICATION NUMBER: *60/478,397*
FILING DATE: *June 13, 2003*
RELATED PCT APPLICATION NUMBER: *PCT/US04/18616*

Certified by

Jon W. Dudas

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

Attorney Docket No.: BAE-20030073

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In ~~re~~ application of: Eugene S. Rubin

Entitled: Low Cost Aircraft Self Protection Suite

BOX PROVISIONAL PATENT APPLICATION
Commissioner of Patents
PO Box 1450
Alexandria, VA 22313-1450

PROVISIONAL APPLICATION COVER SHEET

(37 C.F.R. §1.51(2)(i))

CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this correspondence and the documents referred to as attached therein are being deposited with the United States Postal Service on **June 13, 2003**, in an envelope as "EXPRESS MAIL POST OFFICE TO ADDRESSEE" service under 37 C.F.R. 1.10, Mailing Label Number EV333019422US, addressed to the: Box Provisional Patent Application, Commissioner of Patents, PO Box 1450, Alexandria, VA 22313-1450.

Wendy A. Antonelli

This is a request for filing a PROVISIONAL APPLICATION under 37 CFR 1.53(c).
Inventor(s) (§1.51(c)(1)(ii):

Full Name of /First Inventor: Eugene S. Rubin		
City of Residence	State or Country	Country of Citizenship:
Post Office Address	City	State or Country Zip Code

Enclosed are:

[X] 9 pages of specification (§1.51(c)(2)
[X] ___ sheets of informal drawings (one set) (§1.51(c)(3)
[ ] Power of Attorney
[ ] Assignment
[X] Other: Deposit Account 190130 Authorization

[ ] Applicant claims small entity status (§1.9 and §1.27)

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government (§1.51(c)(1)(viii).
[x] No.
[ ] Yes, the name of the U.S. Government agency and the Government contract number are: _____

The filing fee of $160.00, as set forth in 37 C.F.R. §1.16(k) is:
[X] to be charged to Deposit Account 190130 (Authorization enclosed).
[ ] not enclosed

[X] Should there be any problems in charging the above fee to Deposit Account No. 190130, the Commissioner is hereby authorized to charge any additional filing fees under §1.16 associated with this communication and credit any overpayment to Deposit Account No. 02-3285.

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June 13, 2003
Date

[redacted]

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application	:	Eugene S. Rubin
Serial No.	:	
Filed	:	June 13, 2003
For	:	Low Cost Aircraft Self Protection Suite
Examiner	:	
Attorney's Docket	:	BAE-20030073
Group Art Unit	:	

I hereby certify that the following items are being deposited with the United States Postal Service ``Express Mail Post Office to Addressee'', label no. EV333019422US addressed to: Mail Stop Provisional Application, Commissioner of Patents, PO Box 1450, Alexandria, VA 22313-1450 on June 13, 2003.

By _____
Daniel J. Bourque
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Attorney for Applicant(s)

L E T T E R

Mail Stop Provisional Application
Commissioner of Patents
PO Box 1450
Alexandria, VA, 22313-1450

Sir:

DEPOSIT ACCOUNT 190130 AUTHORIZATION

The Office is hereby authorized to charge the required $160.00 fee, and any deficiency or credit any overpayment in the fees to the above deposit account, owned by BAE SYSTEMS Information and Electronic Systems Integration Inc. an authorized signator for which is Kevin M. Perkins, V.P. & Company Counsel, and for whom the undersigned are authorized agents. Triplicate copies of this transmittal letter are enclosed.

[redacted]

In Re: Eugene S. Rubin
Filed: June 13, 2003
Group Art Unit:

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Docket No.:BAE-20030073

PROVISIONAL PATENT APPLICATION SPECIFICATION

LOW COST AIRCRAFT SELF PROTECTION SUITE

TECHNICAL FIELD

[001] The present invention relates to aircraft protection and more particularly, to a number of methods for protecting an aircraft from missile or other projectile fire both during takeoff and during flight.

BACKGROUND

[002] It is well known that missiles and other ordinance or projectiles fired at aircraft in order to destroy the aircraft typically rely on heat or other infrared or light energy for guidance and direction purposes. This is why, ordinarily, aircraft that are shot down, are often destroyed by having a missile strike an engine. Since the engines of the aircraft are the biggest source of such radiation, they form an easy target for a missile.

[003] Although there are a number of methodologies to both detect an oncoming missile to detect an incoming missile, mask or otherwise hide a source of radiation, and/or deploy false sources of such radiation to trick missiles into tracking the wrong target, all such system have proven to be very expensive, and in

some instances, not very effective.

SUMMARY

[004] Accordingly, the present invention features, in one embodiment, a method of alerting a pilot of an incoming missile. In another embodiment, the present invention features a method of masking or reducing an aircrafts infrared or other radiation "view" vis-à-vis an object which is tracking that source. In yet another embodiment, the present invention features a method for deploying "fake" or "false" sources of radiation behind an aircraft such that an incoming missile will track the false target and thereby miss the aircraft.

[005] In one embodiment, the invention features a method for reducing or somewhat masking the effects of the largest source of radiation from an aircraft, namely, from the aircraft engines. This embodiment of the invention relies on the insertion of oil or other liquid into the aircraft engine. The effects of the oil, as describes herein, is to mask or significantly minimize the radiation which emanates from the engine because of the mist or fog caused by the oil injected into the engine.

[006] In yet another embodiment, the present invention features the deployment of objects behind an aircraft during flight. These objects emit radiation from an energy source, such as a laser, disposed within the aircraft towing the one or more objects. These objects serve as a source of radiation which

attract missiles or which missiles are more likely to track, than the aircraft. Thus a missile would miss an aircraft and harmlessly be attracted to the device being towed by the aircraft. In this embodiment, the source of radiation is located in the airplane. The invention features a means for channeling the radiation from the source of radiation in the airplane to the device being towed outside the airplane. In the preferred embodiment, this includes a fiber optic cable, which is able to transmit the infrared radiation or other energy from the airplane and transfer it to the drone or object being towed. Thus, from the perspective of a missile or other projectile, the one or more drones or objects being towed by the plane become a bigger or more visible "target", and thus attract the missiles and miss the aircraft.

[007] Additional details can be found herein.

[008] Modifications and substitutions by one ordinary skill in the art are considered to be within the scope of the present invention.

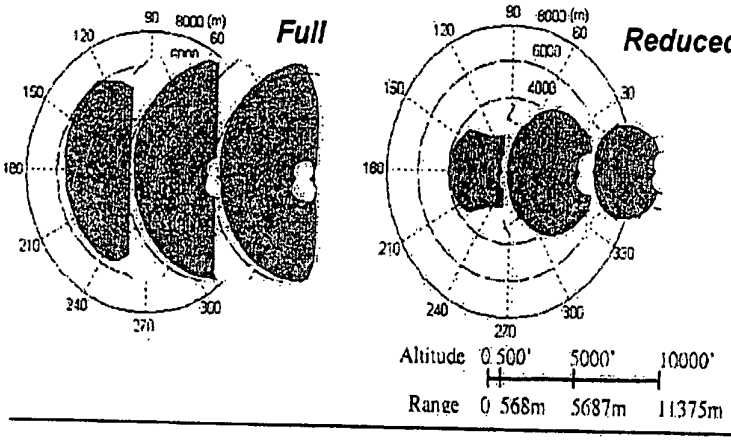
ABSTRACT

A suite of low cost, aircraft protection methods and devices are provided. In one embodiment, the invention includes a method for alerting an aircraft to the fact that a missile or other projectile has been launched and is closing in on the aircraft. In another embodiment, the invention features a method for making the aircraft's high visibility components, such as the engines, more invisible to missiles or projectiles by adding to the engine an oil or other liquid or matter which causes a "fog" or mist in the exhaust thereby masking the presence of the engine's exhaust. In a further embodiment, the invention features deploying one or more devices tethered behind and to the aircraft. A source of radiation or energy aboard the aircraft, such as a laser or light source, is directed by a conduit, such as by one or more fiber optic cables, from the source of radiation in the aircraft to the device being towed behind the aircraft. In this manner, the device that is being towed behind the aircraft serves as higher visibility points thereby attracting missiles or other projectiles fired at the aircraft. The missiles or other projectiles thus past harmlessly behind the aircraft, which is the intended target, and instead strike one or more high energy objects being towed behind the aircraft.

Quad Chart - Format

BAA Number: *TSWG DAAD05-03-T-0024 DHS*
Mission Area: *MANPADS Countermeasures*
Requirement Number: *R1039*
Proposal Title: *Hotspot Masking to Improve Survivability*

B1 Vulnerability Take-off



Operational Capability:

1) Maximize survivability by minimizing threat signature
2) Low cost A and B Kits
3) Low R&M cost
4) Minimum impact on AC Operation
   Injection into exhaust plume only
5) Response active only following warning alert
6) All equipment housed internally

Proposed Technical Approach

Reduce AC Signature by Hot Spot Masking to minimize vulnerability contour and required decoy irradiance to protect AC.

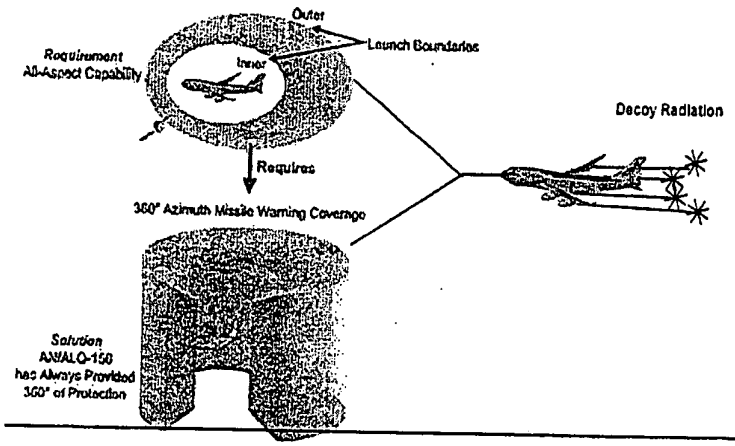
a) • Exploit USAF, GE, Army and Defense Research Establishment (Sweden) studies on Obscurant Turbine
   • Proceeding of the Smoke/Obscurant Symposia
   • Adaptation of XM5616 IR Module for USAF Obscurant Turbine, etc.

b) • Inject into test engine exhaust plume multi-spectral water, fog-oil, fog-oil with graphite.
   • Determine percent reduction of signature as a function of injected pounds/min Band I and IV (Injection for max-duration of MANPAD flight)

c) Utilize BAE Jam lab to perform trade-off on percent signature reduction vs. Reduced vulnerability zone and decrease in decoy/jammer irradiance to protect AC in take-off and landing.

Quad Chart BAA Number: *TSWG DAAD05-03-T-0024 DHS*
- Format Mission Area: *MANPADS Countermeasures*
Requirement Number: *R1039*
Proposal Title: *Virtual Decoy for Protection of Commercial Aircraft*

Proposed Concept



Operational Capability:

1) Maximum use of production proven hardware
2) Low cost hardware suite
3) Minimum A Kit costs
4) Low R&M costs
5) Very low drag increment to basic AC
6) All equipment housed internally except during threat alert
7) Warning system active only during landing approach & take-off
   Response active only during time of flight of threat missiles
8) Provide effective decoy. Extended source, $J/_S$>2

Proposed Technical Approach

Task 1: Exploit break-through in fiber optics to create virtual IR decoy by coupling selective emitter source into deployed fiber optics light pipe.

Task 2: Reduce AC Signature by Hot Spot Masking to minimize vulnerability contour and required decoy irradiance to protect AC.

Task 3: Utilize recent successes in deployment/retraction of towed expendable to create off-board IR decoy with on-board source.

Task 4: Take advantage of AN/ALQ-156A VECP to minimize false alarm rate while maximizing warning time

Task 5: Maximize use of production proven hardware to minimize cost, development time, operational impact and R&M.

Quad Chart - Format

BAA Number: *TSWG DAAD05-03-T-0024 DHS*
Mission Area: *MANPADS Countermeasures*
Requirement Number: *R1039*
Proposal Title: *Towed Virtual IR Decoy*

Fiber Optic Test Reel

Operational Capability:

1) Maximize survivability by minimizing threat signature
2) Low cost A and B Kits
3) Low R&M cost
4) Minimum impact on AC Operation
   Injection into exhaust plume only
5) Response active only following warning alert
6) All equipment housed internally

Proposed Technical Approach

Exploit break-through in fiber optics to employ a towed fiber-optic cable to guide optical radiation from a source on-board the aircraft to a position behind the aircraft, thus offering a false target for an incoming guided munition.

a) Review exciting new work at NRL on optical fibers for transmission in the MANPADs threat bands
b) Utilize work by Avionics Directorate Wright Patterson AFB on Off-board laser countermeasure program
c) Make use of extensive off-board decoy development by the Large Aircraft Defensive Systems Program office at BAE. The retrieval control unit comprises the A-kit and the deployment/retraction unit in the B-kit
d) Develop optical design to couple selective - emitter black-body source into deployed optical cable. Use sources developed for BAE's ALQ-144 and ISDS.

COMPANY PRIVATE
Commercial Aircraft Self Protection Suite

It has long been known that transport aircraft are extremely vulnerable to a man-portable (MANPADS) surface to air infrared missiles. In particular during its take off run and climb to altitude under full power the fully loaded transport, fuel and cargo, it is in its slowest least maneuverable flight regime while radiating its largest IR signature. Accordingly it is a desirable target for a lone terrorist armed with a suitable IR weapon.

In the past BAE SYSTEMS have successfully protected such high priority vehicles with deceptive IR Countermeasures systems such as the SDS and ISDS as well as versions of the ALQ-144. Today more advanced systems such as ATIRCM-CMWS or DIRCM are available and highly effective, however their cost and size makes them all totally impractical for the already overburdened commercial aircraft industry.

The following describes a BAE proposed low cost readily available solution to this critical problem (under 100K).

Basic to our solution is the BAE ALQ-156 a highly effective missile warning radar, which has been in production here for over 15 years. The 156 it is a small L-band high sub-clutter visibility system that surrounds the vehicle with a threat warning ring, determines that a missile has been launched, is closing in and that you are the target. Finally it provides the time before you will be hit if no further action is taken. For this application only the rear azimuth need be monitored.

In the preferred approach, the ALQ-156 would be activated automatically during the take off run and turned off once the aircraft had attained a specific safe altitude.

As an alternative to the above process we may add a simple wide-angle passive infrared detector with suitable processor. This detector will act as an Alarm clock, simply saying an event with the appropriate IR signature has occurred, turn on the ALQ-156. Obviously rough directive information may be obtained by proper installation of these simple IR detectors should it be deemed desirable. Once the 156 decides that you have been fired on we next activate an IR countermeasure in the form of IR chaff. Currently the 156 triggers an IR expendable flare to detract the incoming missile but that hazard is not acceptable for commercial applications. IR Chaffs such as burning metal foils, etc are acceptable but add complication and cost. Instead we inject raw oil directly into each engine's exhaust stream. (Several years ago it was common customs for several airlines to inject water into jet engine exhausts to increase thrust during take off. We envision similar equipment here except that we inject oil). Oil fog has an extremely high infrared broad-based extinction coefficient. When emitted at the appropriate rate the resultant cloud is opaque to mid-band IR and will reduce the target signature below that needed for the missile to track. The blinded missile will either follow a ballistic trajectory to the ground or continue on the last indicated flight path. At this point a simple climb-out maneuver on the part of the pilot will guarantee a miss. Alternatively a low power expendable may be ejected to give the blinded missile a new target to chase. This addition complicates our solution and adds some cost but may be necessary, as the MANPADS missile becomes smarter. Unlike standard flares, this one to be effective needs only a small signature and a short burn time so that if not destroyed by the missile it will burn out before it can reach the ground. Here we suggest our towed decoy technique with the IR decoy. No more than two decoys need be carried and the ground fire hazard is eliminated.

[redacted]

As an alternative to dumping oil directly into the aircraft engine exhaust, commercial oil smoke generators similar to those used in the orange groves to protect against frost may be used to create the obscurant. In either case we must control oil drop size to maximize extinction. Naturally, oil tanks must be refilled periodically.

A small series of tests will be necessary to maximize effectiveness but the total system cost including installation should be on the order of 100K per aircraft in small production runs.

Gene Rubin

[redacted]

Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/US04/018616

International filing date: 10 June 2004 (10.06.2004)

Document type: Certified copy of priority document

Document details: Country/Office: US
Number: 60/478,397
Filing date: 13 June 2003 (13.06.2003)

Date of receipt at the International Bureau: 25 April 2005 (25.04.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

World Intellectual Property Organization (WIPO) - Geneva, Switzerland
Organisation Mondiale de la Propriété Intellectuelle (OMPI) - Genève, Suisse